6.0 SUMMARY AND STRATEGY FOR DEVELOPING THE DATA COLLECTION PLAN

The conceptual model provides a description of mercury behavior in the Guadalupe River Watershed that is based on the analysis of the existing data and the results of the Synoptic Survey. The conceptual model also provides new perspectives and identifies several fundamental hypotheses and questions that need to be addressed in developing the watershed-wide mercury TMDL.

The hypotheses and questions identified in the development of the conceptual model provide the starting point for the data collection plan that will be developed and implemented in Task 5 of the Guadalupe River Watershed Mercury TMDL (SCVWD, 2002). The stated purpose of the data collection effort in Task 5 is to "reduce uncertainty with respect to the estimated significance of processes, the estimated magnitudes of mercury loads ...". But the data collection effort must also provide the necessary information to establish a link between the sources of Hg in the watershed and the maximum amount of mercury that can exist within the waterbody while still meeting water quality standards.

The following discussion of the TMDL data requirements serves as a summary of the findings of the conceptual model.

6.1 MERCURY SOURCES AND LOADING

Measurements of mercury concentrations at different points in the watershed are required to quantify the loading associated with the different sources. Measurements of mercury, TSS, and flow rates during winter storms are needed at several locations. The data requirements vary according to waterbody type:

- **Reservoirs**. Mercury loading to the reservoirs from atmospheric deposition has been estimated using existing wet and dry deposition data collected at various locations around San Francisco Bay (see Chapter 5). Atmospheric sources and runoff from waste materials may both be important within the sub-watersheds of Almaden and Guadalupe Reservoirs. At Calero and Lexington Reservoirs the potential exists for mercury contributions from the bedrock and soils. Measurement of total mercury and methylmercury (particulate and dissolved), TSS, and flow rates will be required throughout the course of selected storm events.

- **Streams and creeks in the upper watershed, above Ross Creek**. Measurements of TSS, total mercury, and flow rates are required at multiple locations on Alamitos Creek and Guadalupe Creek. Emphasis needs to be on sampling near known or suspected sites of enhanced erosion and scour and at locations receiving runoff from waste piles. Sampling should also be conducted above and below drop structures or impoundments to assess effects of these structures on sediment transport. Data on quantities removed at each structure will be obtained to evaluate the effectiveness of District sediment removal efforts.

- **Creeks in the watershed draining areas not known to contain mines**. Measurements of TSS, total mercury, and flow rates are required at multiple locations along Los Gatos Creek, Ross Creek and Canoas Creek.

- **Guadalupe River downstream of Almaden Lake to Coleman Avenue**. Measurements of TSS, total mercury, and flow rates are required at multiple locations. Emphasis should be on sampling above and below drop structures to assess effects of these structures on sediment transport. During the sampling design phase, the importance of and the ability to accurately compare suspended solids transport versus bed load transport will be assessed**.**

- **Guadalupe River from Coleman Avenue to Alviso Slough**. Measurements of TSS, total mercury, and flow rates are required at multiple locations. This sampling should be coordinated with Clean Estuary Partnership sampling program at the USGS gauging station.

6.2 MERCURY PRODUCTION, FATE & TRANSPORT PROCESSES

The results of the Synoptic Survey indicate that a portion of the mercury in solids conveyed to the reservoirs enters the solution phase and represents a significant source of bioavailable methylmercury. However, answers to several questions are

crucial to establishing a TMDL linkage and to providing a basis for developing and implementing effective intervention strategies.

- **Where is mercury methylated in the system?** The high level of methylmercury at the outlets of the reservoirs offers strong evidence that the anoxia that occurs in the lower waters during summer stratification facilitates mercury methylation. However, the location of mercury methylation in the reservoirs was not pinpointed in the Synoptic Survey. Spatially and temporally detailed measurements of total and methylmercury (dissolved and particulate) are required in the reservoirs before, during, and after thermal stratification becomes established in the summer.

The Synoptic Survey showed a decrease in methylmercury concentration in the creeks with distance downstream from the reservoirs. The implication is that the creeks are net demethylators. This is not to say that methylation was not occurring in the creeks, but only that in-creek methylation rates did not keep up with the loss rates. In-stream methylation may still be significant and may be preventing a further decrease in methylmercury concentration. This hypothesis needs to be confirmed through paired mercury and methylation-rate measurements in the sediment and overlying waters of the creeks and river.

- **What are the mechanisms of mercury methylation?** The TMDL process requires the ability to both predict the reduction in mercury or methylmercury concentration that is required to achieve the selected numeric target(s) and to identify effective interventions. The establishment of this predictive ability requires the identification of the crucial mercury source (e.g., crystalline and amorphous HgS and absorbed mercury in sediments, or dissolved mercury in the water column). Also the local dependencies of the production of methylmercury by sulfate reducing bacteria need to be clarified. Field and/or laboratory measurements of methylation rates at several locations in the water column and sediments under a variety of conditions (e.g., relative degree of anoxia, sediment mercury concentrations, temperature) and locations (littoral wetlands, backwaters, etc.) are required.

6.3 BIOACCUMULATION

The TMDL requires the ability to link reductions in methylmercury production to reductions in the selected assessment endpoints. It appears that fish tissue mercury concentrations are a logical choice as an assessment endpoint for which a numeric target for the TMDL can be developed. Waterbody-specific relationships between aqueous methylmercury concentration (C_{water}) and fish tissue concentrations ($F_{i, j, l}$) are expected be of the following form:

$$F_{i, j, l} = K_{i, j, l} C_{water}$$

where:

K = the water-fish partition coefficient
i = selected fish species
j = fish size class
l = reservoir or water body segment

This type of function would be used in conjunction with a methylmercury production function to complete the linkage analysis. However, the ability to predict the response of mercury concentrations in fish tissue to reductions in aqueous methylmercury concentrations is independently important because it can be used to address questions regarding the effectiveness of potential intervention strategies or devices. For example, will the reduction of dissolved or methylmercury concentrations in reservoirs, achieved by artificially aerating the reservoir or its hypolimnion, result in reductions in mercury concentration in fish tissue?

Establishing a quantitative relationship between sediment mercury concentrations, mercury concentrations in the water, and fish tissue levels is important. Armed with such information, the determination of the sediment-concentration reductions required to achieve selected target concentrations of mercury in fish tissue (e.g., 0.3 mg/kg) can be specified. Achievement of this level of prediction will be challenging, yet will be necessary to support the quantitative linkage essential to developing credibility in the TMDL process.

6.4 DATA COLLECTION PLANS

The next step in the Guadalupe Rive Watershed Mercury TMDL process is the development of the data collection plan. The data collection program will include controlled, in-lake or in-stream, experiments and field sampling. The primary challenge will be to develop information that is useful for constructing the required predictive relationships between mercury concentrations in sediment, water, and fish. An encouraging aspect of the problem is that the four reservoir-stream systems (Chapter 3) present characteristics that are conducive to these requirements. The "laboratory" conditions are relatively consistent: the waterbodies exhibit similar basic water quality/chemistry characteristics (e.g., alkalinity, pH, productivity, DOC, SO_4, and temperature). At the same time, there is a wide range and non-uniformly distributed set of values for mercury speciation, concentration and levels in biomass. This bodes well for the ability to examine the response of elements of the system to a wide range of changes in mercury ambient concentration and loading.